

CLAIMS

What is claimed is:

1. An external counterpulsation apparatus for treating a patient, comprising:
 - a plurality of inflatable devices adapted to be received about the lower extremities of the patient;
 - a source of compressed fluid in communication with said plurality of inflatable devices; and
 - a fluid distribution assembly interconnecting said source of compressed fluid and said inflatable devices and including a selectively operable inflation/deflation valve interconnected between each of said inflatable devices and said source of compressed fluid, said fluid distribution assembly distributing compressed fluid from said source of compressed fluid to said inflation/deflation valve and separately operating each said inflation/deflation valve to sequentially inflate and sequentially or simultaneously deflate each of said inflatable devices, each said inflation/deflation valve having an input in fluid communication with said source of compressed fluid, an inflation/deflation port in fluid communication with one of said inflatable devices, and a deflation exhaust port in fluid communication with the atmosphere, said deflation exhaust port being normally open so as to exhaust compressed fluid upon loss of power to the external counterpulsation apparatus.

2. An apparatus according to claim 1, further comprising a fluid reservoir interconnecting said source of compressed fluid and said inflatable devices, said fluid reservoir providing compressed fluid to said inflatable devices.

3. An apparatus according to claim 1, further comprising a power operator connected to each of said inflation/deflation valves and separately operable such that each of said inflatable devices is separately and sequentially inflatable and deflatable.

4. An apparatus according to claim 3, wherein said power operator is electrically actuable.

5. An apparatus according to claim 3, wherein said power operator is pneumatically actuable.

6. An apparatus according to claim 1, wherein each of said inflation/deflation valves is a two-position, three-way solenoid valve.

7. An apparatus according to claim 1, wherein each of said inflation/deflation valves is connected to a negative pressure reservoir.

8. An apparatus according to claim 1, wherein each of said inflation/deflation valves is a rotary actuatable valve.

9. An apparatus according to claim 1, wherein each of said inflation/deflation valves is a rotary actuatable butterfly valve.

10. An apparatus according to claim 9, wherein each of said rotary actuatable butterfly valves includes a pair of said butterfly valve elements attached to said rotor for rotation therewith, a first of said butterfly valve elements disposed normally closed in fluid communication between said input and said inflation/deflation port of said inflation/deflation valve, and a second of said butterfly valve elements disposed normally open in fluid communication between said deflation exhaust port and said inflation/deflation port of said inflation/deflation valve.

11. An apparatus according to claim 10, wherein each of said rotary actuatable butterfly valves includes a rotatable rotor and a butterfly valve element rotatably attached to said rotor for rotation therewith, said rotor being rotatable through a maximum rotation angle of approximately 60 degrees between open and closed positions of said butterfly valve element.

12. An apparatus according to claim 1, further comprising a movable table upon which the patient is situated during treatment, said inflation/deflation valves being attached to said movable table for movement therewith.

13. An apparatus according to claim 12, wherein said movable table includes a plurality of wheels attached thereto.

14. An apparatus according to claim 12, wherein said inflation/deflation valves are mounted to said movable table.

15. An apparatus according to claim 12, wherein said movable table further includes an articulating portion and a main portion and allows selective angulation of said articulating portion with respect to said main portion.

16. An apparatus according to claim 15, wherein said movable table includes an elevation assembly selectively operable to adjust the height of said articulating and main portions.

17. An apparatus according to claim 1, further comprising an inflation passageway and a deflation passageway through each of said inflation/deflation valves, said inflation passageway disposed between said input port and said inflation/deflation port being more restricted than said deflation passageway between said inflation/deflation port and said deflation exhaust port.

18. An external counterpulsation apparatus for treating a patient, comprising:

- a plurality of inflatable devices adapted to be received about the lower extremities of the patient;
- a source of compressed fluid;
- a fluid reservoir interconnected with said source of compressed fluid for inflating said inflatable devices; and
- a fluid distribution assembly interconnected with said fluid reservoir for distributing compressed fluid from said source of compressed fluid to said inflatable devices;

said fluid distribution assembly including a selectively operable inflation/deflation valve interconnected between each of said inflatable devices and said fluid reservoir, each of said inflation/deflation valves having a power operator thereon and being interconnected with said inflatable device assembly and separately operable such that each of said inflatable devices is separately inflatable and deflatable, each of said inflation/deflation valves having an input interconnected with said fluid reservoir, an inflation/deflation port interconnected with one of said inflatable devices, and a deflation exhaust port in fluid communication with the atmosphere, said deflation exhaust power being normally open so as to default to said normally open condition upon loss of power to said power operator;

said source of compressed fluid including a compressor, said apparatus further including a power ramp-up device that upon startup of said apparatus converts electrical power to said compressor from 110/120 VAC 50/60 hz to three-phase 220 VAC at a

variable frequency and increases the electrical power to a preselected full power level over a period of approximately three to approximately five seconds.

19. An external counterpulsation apparatus for treating a patient, a treatment table upon which the patient is situatable during the treatment, said treatment table including a main portion and an articulating portion selectively adjustable to a plurality of angulated positions relative to said main portion, said treatment table further including a motor-driven elevation assembly actuable to selectively raise and lower said treatment table to a plurality of different elevated positions.

20. An external counterpulsation apparatus according to claim 19, said treatment table further including a plurality of wheels allowing said treatment table to be selectively moved between a plurality of locations.

21. An external counterpulsation apparatus according to claim 19, wherein said apparatus further includes an inflation/deflation valve for selectively inflating and deflating an inflatable device attachable to the patient, said inflation/deflation valve being mounted on said treatment table and movable therewith.

22. An external counterpulsation apparatus according to claim 19, further comprising a foot-actuable switch on said treatment table, said foot-actuable switch selectively energizing and de-energizing said motor-driven elevation assembly.

23. An external counterpulsation apparatus according to claim 19, wherein said motor-driven elevation assembly includes a limit switch device that limits the elevation of a top of said main portion of said treatment table between 24 inches and 36 inches.

24. An external counterpulsation apparatus according to claim 19, wherein said angulated position of said articulating portion of said treatment table relative to said main portion is limited to 30 degrees above horizontal.

25. An external counterpulsation apparatus for treating a patient, comprising:

a plurality of inflatable devices adapted to be received about the lower extremities of the patient;

a source of compressed fluid in communication with said plurality of inflatable devices;

a fluid distribution assembly interconnecting said source of compressed fluid and said inflatable devices and including a selectively operable inflation/deflation valve interconnected between each of said inflatable devices and said source of compressed fluid, said fluid distribution assembly distributing compressed fluid from said source of compressed fluid to said inflation/deflation valve and separately operating each said inflation/deflation valve to inflate and deflate each of said inflatable devices; and

a pressure regulator assembly in fluid communication with said source of compressed fluid and operable to maintain said source of compressed fluid at a preselected pressure.

26. An external counterpulsation apparatus according to claim 25, wherein said pressure regulator assembly includes a pressure relief valve.

27. An external counterpulsation apparatus according to claim 26, wherein said pressure relief valve is a dome-load pressure relief valve.

28. An external counterpulsation apparatus according to claim 26, wherein said pressure relief valve includes a vent valve open to atmosphere.

29. An external counterpulsation apparatus according to claim 27, wherein said vent valve is biased open to atmosphere.

30. A method of controlling an external counterpulsation apparatus for treating a patient, comprising the steps of:

selecting a patient treatment pressure;

outputting a signal corresponding to said selected treatment pressure;

detecting a reservoir pressure in a pressure reservoir;

comparing said selected treatment pressure to said reservoir pressure;

controlling a pressure regulator valve based on a difference between said patient treatment pressure and said reservoir pressure.

31. The method of controlling an external counterpulsation apparatus according to claim 30, further comprising the step of decreasing said reservoir pressure when said reservoir pressure is greater than a preset difference from said patient treatment pressure.

32. The method of controlling an external counterpulsation apparatus according to claim 31, wherein said reservoir pressure is decreased by venting said pressure reservoir to atmosphere.

33. The method of controlling an external counterpulsation apparatus according to claim 30, further comprising the step of increasing said reservoir pressure when said reservoir pressure is less than a preset difference from said patient treatment pressure.

34. The method of controlling an external counterpulsation apparatus according to claim 33, wherein said reservoir pressure is increased by operating a compressor.